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ABSTRACT

A study examined the interaction between reading ability and text format. Subjects were 120 sophomores and juniors enrolled in reading methods courses at Montclair State College (New Jersey) who were divided into two equal groups of skilled and unskilled readers by means of a diagnostic reading test. Experimental reading passages based upon college texts of approximately 130 words containing equal amounts of information but systematically varied numbers of arguments were presented in two different formats: standard format text (SFT) and list format text (LFT) in which the standard format text was typographically manipulated so that the information presented in meaningful components, based upon semantic propositions, was separated on successive lines of the page. Combining the variables produced four experimental conditions. Results indicated interactive effects between ability and format for skilled readers, from which it can be inferred that they identify and use cues in the text, but evidence of interactive effects between arguments and ability and arguments and format was not found. The number of arguments did affect comprehension. To improve instruction, teachers, text designers, and text writers should take into account the effects of format and the number of arguments. (JL)

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THE EFFECTS OF FORMAT AND NUMBER OF ARGUMENTS ON COMPREHENSION OF TEXT BY COLLEGE UNDERGRADUATES

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Some readers do not receive the instructional message from text. More than the ability to decode and to correctly pronounce words is required for comprehension to occur. Current research of the factors that impede comprehension include manipulation of text organization and format. Textual manipulations which alter the manner in which textual information is presented to readers affect reading comprehension. This paper examines the interaction between reading ability and text format.

Background

A part of comprehension of text is the ability of a reader to remember what was comprehended. Therefore, researchers need a procedure which will enable them to examine the textual information recalled by readers, as well as the way information is stored in memory. The paradigm used by many researchers is to ask subjects to recall in writing, information read. Then, the content of the written recall is analyzed.

Examination of written recalls, of readers varying in reading ability, has shown that skilled readers remember more than unskilled readers (Kintsch, Kozminsky, Streby, McKoon and Keenan, 1975). What skilled readers recall is probably a function of how they store propositions in memory.

In order to place information into propositional form in memory, the reader must make an association, visualize a concept, or in some other way, interact with the text (Frase, 1970; 1975). We can say that when a reader can express information propositionally, which includes being aware of relationships between the concepts expressed in prose, comprehension occurs.

Researchers in comprehension have considered factors such as the amount of information presented within a sentence. Several investigations (Kintsch, 1974; Kintsch et al., 1975; Manelis & Yekovich, 1976) have manipulated the

structure of text by varying the number of arguments within propositions. Given several passages to read, some with few and some with many arguments within propositions, these researchers found that subjects' written recalls demonstrated greater comprenension of those passages containing few arguments. The findings of these studies indicate that the greater the number of different arguments there are within propositions in text, the more difficult will be comprehension of that text.

In addition to the research dealing with propositions presented in text, another aspect of research has been focusing on the text itself. Results of recent investigations have shown that while the message the author is trying to convey is important, and will constrain text to some degree, i.e., the terms used and the ideas expressed, certain textual characteristics can be manipulated without changing the message.

In recent studies by Schwartz, Fisher & Frase (1977), and Mason & Kendall (1978), it was shown that comprehensibility improved when sentence components were manipulated so that their interrelations were more clearly delineated for the reader. Schwartz et al. (1977) reported that listing sentence components separately led to improved comprehensibility.

In their study, it was shown that the list format was more rapidly processed than standard prose format. Their findings suggested that "sentence inefficiency" (Schwartz et al., 1977) or failure to comprehend was a consequence of the inability of readers to segment meaningful groups of information. In addition, Frase and Schwartz (1977) showed that separating sentences by indenting meaningful units reduced the length of time needed to comprehend information, and Mason and Kendall (1978) found that low ability readers' comprehension scores improved when intrasentence structures were

separated, and a list format was used to present textual information.

Previous studies have shown that varying the format of the presentation of the information can improve the comprehensibility of the text (Schwartz et al., 1977; Frase, 1970; Mason & Kendall, 1978) and that one of the factors which significantly affects comprehension is the number of arguments within propositions in text (Kintsch et al., 1975; Manelis & Yekovich, 1976). The present study investigated the relationships between format, number of arguments and comprehension.

Subjects

Sophomores and juniors enrolled in reading methods courses at Montclair State College in New Jersey during the academic year 1979 were given a screening test, The Diagnostic Reading Test, prior to the onset of the study. The means and the standard deviation for the Montclair State College students were calculated in order to assign students to groups of "skilled" and "unskilled" readers. Those students whose comprehension scores fell above one-half a standard deviation above the mean were grouped and categorized as skilled readers. Students whose scores fell below one-half a standard deviation below the mean were grouped and categorized as unskilled readers. One hundred twenty students (sixty skilled readers and sixty unskilled readers) were randomly selected to participate in the experiment.

Materials

The experimental passages devised for this study were similar to and based upon selections from college text books. The subject matter, operant conditioning, was selected as appropriate for the subjects of the study

because both the specific contents of the passages, and the manner in which specific technical concepts are presented, are part of the curriculum of Montclair State College.

The passages were devised to approximate an explanatory passage in a college text in length (approximately 130 words per passage) and in the amount of information presented in a passage (approximately 30 propositions per passage). Both the number of words and the number of propositions were held constant across all passages. The number of arguments within propositions per passage were systematically varied, using twice as many arguments within propositions in the many arguments condition than were used in the few arguments condition. Thus, for this study about twelve arguments were present in passages in the few arguments condition, and about twenty-four arguments were present in passages in the many arguments condition. In order to control for the extraneous effects of repeated arguments, only different arguments used in the passages were counted as few or many. In addition, a measure of syntactic density (Botel, Dawkins & Granowsky, 1972), and a word familiarity rating (Dale & O'Rouke, 1979), was computed to insure comparability across all passages.

Two formats of each passage were devised. In one, the standard format text (SFT) was used, in the other format the standard format text was typographically manipulated so that the information presented in meaningful components, based upon semantic propositions, was separated on successive lines of the page to construct the list format text (LFT).

A booklet was constructed consisting of the four different passages, selected so that each subject would have an opportunity to be exposed to a passage prepared in each of the following four experimental conditions:

standard format and list format; few arguments and many arguments. There was a blank page following each of the pages containing the experimental passages.

Results

The data for testing hypotheses with analysis of variance were the four scores of 120 subjects designated Skilled and Unskilled Readers on number of propositions recalled for each of the four experimental passages. The results of an analysis of variance on proposition recall scores as a function of reading ability, format and number of arguments are presented in Table 1. Main effects were found for reading ability ($p < .01$), for format ($p < .01$), and for arguments ($p < .01$). Interactive effects were found between ability and format ($p < .01$). Evidence of interactive effects between arguments and ability, and between arguments and format, was not found in the data. The results of an analysis of variance for the simple effects of format and reading ability are presented in Table 2. Examination of the data in the table indicate that it is the skilled readers scores which interacted with format.

Discussion

Results of the study suggest support for the findings of Kintsch et al. (1975) and Manelis & Yekovich (1976) that the number of different arguments in text will affect comprehension. In this study passages written with many arguments were more difficult to comprehend than were passages written with few arguments, as measured by the mean scores of propositions recalled. Although there was a main effect for arguments, it is the absence of an

interactive effect of arguments with ability, and of arguments with format, that is especially interesting. It has been hypothesized that encoding skill is a factor affecting comprehension (Perfetti & Goldman, 1976; Lesgold & Perfetti, 1977), and that segmenting text might assist the short-term memory system to process elements of text more efficiently (Schwartz et al., 1977). The results of this study suggest that the manipulated format did not assist the short-term memory system to process many textual elements for either skilled or unskilled readers. In fact, both skilled and unskilled readers performed in similar ways, at least in their ability to deal with many arguments. Unskilled readers and skilled readers achieved lower mean scores with text containing many arguments, than with text containing few arguments. One can infer that the strategies skilled readers have for comprehending text do not include an ability to effectively process many arguments.

Another finding of this study supports the research findings of Schwartz et al., (1977), that a manipulated format facilitates comprehension. The present study sampled readers from two populations, skilled readers and unskilled readers, in order to examine variance due to stratefied sampling. The data indicate that skilled readers achieved higher scores, as measured by the mean scores of propositions recalled, when asked to recall information written in list format text. One may infer that part of a skilled reader's strategy for dealing with text is the ability to identify and to use cues in text, in order to facilitate comprehension. For the unskilled readers, however, comprehension was not enhanced with the manipulated format. The mean recall scores of unskilled readers were, in fact, slightly lower with the list format text. Mason and Kendall (1978) found that unskilled readers

spent more time processing non-standard format text than did skilled readers. Their findings suggested that unskilled readers did not attend to propositional information. In this study, the findings of Mason and Kendall (1978) were supported, in that unskilled readers were not sensitive to the comprehension cues provided by the manipulated format. In fact, it is possible that for unskilled readers, the list format served to draw attention to the format, and away from the content, of the passage.

In fact, an examination of the unskilled readers recall protocols indicate that many unskilled readers utilized a list format for writing their recalls. The unskilled readers did not, however, include the same semantic units in their recall protocols.

Educational Importance of the Study

The acquisition of knowledge in most school situations depends on the students' ability to comprehend text. The finding that skilled readers achieved greater comprehension with passages written in list format suggests that a list format may be a useful device for helping to improve comprehension of text. In addition, the conclusions indicated that the ability to discern semantic proposition in text is critical for comprehension. Assumptions that students can effectively learn from their textbooks should be discarded by content teachers and replaced by systematic instruction in selecting appropriate semantic propositions from the text. The data further suggest that since skilled and unskilled readers had more difficulty recalling propositions containing many arguments than few, educators need to attend to the amount of information presented within a passage.

It was concluded in the current study that format factors facilitate comprehension for skilled readers; and that passages written with many arguments were more difficult to comprehend than were passages written with few arguments in propositions. Designers of textbooks are encouraged to consider that manipulation of such characteristics can reduce the possibility that the processing capacities of learners will be taxed or overloaded. Finally, textbook writers and publishers should not rely heavily upon readability formula factors when assessing textbook difficulty while overlooking powerful content factors. The effects of textual format, the number of elements contained in a passage, as well as the vocabulary terms employed, must also be considered.

Table 1

Three-Way Analysis of Variance of Scores by Reading Ability Grouping, Format, and Number of Arguments with Repeated Measures on Format and Number of Arguments

Source of Variation	Sums of Squares	df	Mean Squares	F
Total	5876.92	479		
Between subjects	3708.66	119		
Reading Ability	1134.67	1	1143.67	52.02**
$Error_1$	2573.99	118	21.81	
Within subjects	2168.26	360		
Format	36.30	1	36.30	8.75**
Arguments	56.03	1	56.03	8.53**
Reading Ability x Format (R x F)	73.63	1	73.63	17.74**
Reading Ability x Arguments (R x A)	8.13	1	8.13	1.24
Format x Arguments (F x A)	8.00	1	8.00	1.33
Reading Ability x Format x Arguments (R x F x A)	14.01	1	14.01	2.34
$Error_2$	489.27	118	4.15	
$Error_3$	775.17	118	6.57	
$Error_4$	707.75	118	6.00	

$Error_1$: Subjects within groups error

$Error_2$: Format x Subjects within groups error

$Error_3$: Arguments x Subjects within groups error

$Error_4$: Format x Arguments x Subjects within groups error

*$F_{.01}$ (1, 118) = 6.84

Table 2

One-Way Analysis of Variance for Simple Effects of Format and Reading Ability for Mean Number of Propositions Recalled

Source of Variation	df	Mean Square	F
List Skilled vs. List Unskilled	1	893.205	63.316**
List Skilled vs. Standard Skilled	1	106.666	7.800**
List Skilled vs. Standard Unskilled	1	788.437	57.655**
List Unskilled vs. Standard Skilled	1	382.539	27.973**
List Unskilled vs. Standard Unskilled	1	3.267	0.239
Standard Skilled vs. Standard Unskilled	1	315.104	23.042**

**F .01 (1, 476) = 6.70

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